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17. ABSTRACT (MAX. 250 WORDS) Six fifth grade science units are presented: Sound and Light in Communication; Living Things; Weather; Earth and Its Resources; Motion and Foreign Transportation; and Electromagnets. The interest level is appropriate for fifth-graders, but three reading ability levels grades one, three,and five are provided. The teacher is thus enabled to motivate children through interest-arousing field trips, science experiments, or demonstrations, and then to provide them with reading material designed to fit both interest and ability.

The manual is an exploratory effort, designed both to improve learning of fifth-grade pupils in the curricular areas of science and reading, and to illustrate to teachers how they may construct and adapt materials to meet the emerging needs of disadvantaged children.

A list of words deriving from science content and supplementary needs is provided for purposes of preteaching. Such vocabulary should be taught concretely, using science experiment material. Drill sheets in language arts and reading skills are to be used after pupils have read appropriate selections and seek to evaluate the extent to which essential reading skills have been mastered. Science drill sheets test learning of content. A bibliography and a list of useful audiovisual materials are appended.

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TEACHER'S GUIDE

FOR THE UNIT

WHAT MAKES THINGS GO?

BASED ON THE

BOARD OF EDUCATION - SCIENCE SYLLABUS

GRADE 5

UNIT: MOTION AND FORCE
IN TRANSPORTATION

PREPARED AT: Curriculum Center, Mobilization For Youth
Lawrence Brody, Coordinator

U. S. DEPARTMENT OF HEALTH, EDUCATION AND WELFARE
Office of Education

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M O B I L I Z A T I O N F O R Y O U T H

CURRICULUM CENTER

271 EAST 4TH STREET

NEW YORK 9, NEW YORK

A L L R I G H T S R E S E R V E D

1964

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Note: Certain aspects of the initial planning of these units were evolved from the joint efforts of Curriculum Center staff and Richard Kinney, Science coordinator, Board of Education, for D1-4.

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E R R A T A

1. Substitute the word "energy" for "power" in every instance where the word "power" appears in these booklets.

2. Pupil booklet: "Checking Up On What We have learned," Question 3, Level A and B should read "Why" instead of "How ..."

* For purposes of this current tryout, only the unit, "Motion and Force In Transportation" (Titled What Makes Things Go? for this series) is being used. The remaining 5 units will be released at a later date, pending test and revision of this initial unit.

INTRODUCTION TO TEACHER

Effective reading is purposeful reading. Science content presents a wonderful opportunity for the teacher to motivate reading in terms of specific purposes which emerge from a science experiment, a planned field trip or a simple demonstration. As a consequence of these latter activities the student's interest and curiosity become aroused. Once this occurs it is important that the teacher have suitable materials for the pupils to read, for if the student is unable to read the science material, then he becomes almost entirely dependent upon the teacher.

We know that most of the science texts currently available for our students are too difficult for them.[1] This is indeed unfortunate when we realize that:

1. Printed science content materials can develop, extend and refine the student's knowledge of science.
2. Science content, because of the intrinsic motivational nature of the material, can be used as a vehicle of instruction in reading and language arts.

The increasing number of children who experience difficulty in reading is growing not only in disadvantaged, but in advantaged communities as well. However, for the disadvantaged, Mobilization For Youth child, it is felt that motivation for learning is increased by initiation through motoric and visually geared procedures.[2] The science content of these units offers such visual and kinesthetic experience.

The primary purpose of the following units then is to encourage wider and more effective reading. These reading materials have been graded progressively

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1. "Improving Reading in the Junior High School", U.S. Department of Health, Education and Welfare, 1961 Pag. 87
2. Frank Reissman, "The Culturally Deprived Child", Harper & Row Publishers, N.Y. 1962

in three levels of reading difficulty. Each pupil therefore is able to initiate his reading approximately at his own level of achievement and can experience success in reading and comprehension.

We have tried to make provision for individual differences in reading skills and abilities, by providing materials at various levels of difficulty. The material, we believe, does not present serious vocabulary or comprehension difficulties. The sentence structure is simple and the vocabulary is selective. Picture and text have been closely integrated.

HOW TO USE THESE UNITS

The content of these units are six fifth-grade science units. They are: (1) Sound and Light in Communication; (2) Living Things; (3) Weather; (4) Earth and It's Resources; (5) Motion and Force in Transportation; (6) Electromagnets. The interest level is appropriate for fifth-grade with readability approximately set at grades one, three and five levels. Vocabulary is controlled by science content, the Gates word list, and structural changes of words already learned by the children.

This is an exploratory effort, both to improve the learning of fifth-grade pupils in the curricular areas of science and reading, and to illustrate to teachers how they may construct and adapt materials to meet the emerging needs of typical Mobilization for Youth children. Science learning is made more meaningful for the child through a developmental process of doing, conceptualizing and verbalizing. We believe that reading will be improved by motivating through the visual, kinesthetic experience of science activities and a series of prepared reading selections drawn from these activities. Thus, we hope to provide for the children, both a motivation for reading and a successful reading experience.

Procedures:

1. The children carry out the series of experiments for each unit under teacher direction. There is a teacher guide for the science units.

2. There is a different booklet for each unit. Each unit is on three reading levels (grade 1,3,5), each keyed by a different color. Supplementary material in the form of games, stories, and scientific background is provided for purposes of extending and enriching the reading experience.

3. Following pupils reading of appropriate level selections, the teacher will utilize the drill sheets in language arts and reading skills. There are separate drills for each level. Further, these drills are cross-referenced with the lessons. An over-view sheet of all skills used in each unit, broken down according to reading level, is provided. This cross-referencing is detailed in the Language Arts Teacher's Guide. A test sheet on science content is also provided. Answer sheets are provided the teacher for both the Science and Language Arts drill sheets.

4. A list of words deriving from science content and appropriate supplementary needs is provided for purposes of pre-teaching. It is suggested that this vocabulary be taught, wherever possible, concretely, using the materials of the science experiment (realia) and, when each word is first needed for the science lesson. A science glossary is also included.

5. Resources are provided in the form of bibliography, audio-visual materials and free and inexpensive materials.

6. The science drill sheets are designed to test the pupil learning of the science content, while the language arts drill sheets seek to evaluate the extent to which essential reading skills have been mastered. The sequence of skills is derived from New York City Board of Education's latest bulletin on reading in the elementary schools.[1]

The drill sheets are illustrative of some classroom activities which may prove valuable in teaching children who have difficulty with reading.

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1. Sequential Levels of Reading Growth in the Elementary School, Division of Elementary Schools, Board of Education of the City of New York, February 1963.

* Note that throughout the material:

Grade 1 is called "Level A" and is colored yellow.

Grade 3 is called "Level B" and is colored blue.

Grade 5 is called "Level C" and is colored pink.

** Note: Separate lists of new vocabulary are provided. All proper names used in the "Supplementary and Summary" sections are to be taught as need dictates.

Make sure that all skills to be exercised on Drill Sheets are taught in advance of the drills, but following the reading activities.

*** Note how each unit is organized:

Pupil Booklet

1. Science Recall
2. Summary-Conclusion
3. Supplementary material
4. Science and Language Arts Drill Sheets
5. Science Glossary

Teacher Guide

1. Introduction & Instructions for using the package
2. Science Lesson Plans
3. Overview of Language Arts skills utilized
4. Answer sheets for Language Arts and Science drills
5. Resource Material
   a. Bibliography
   b. Audio-Visual Aids
   c. Free Material.
6. Vocabulary lists

Lesson Plans for WHAT MAKES THINGS GO?

Based on MOTION AND FORCE IN TRANSPORTATION

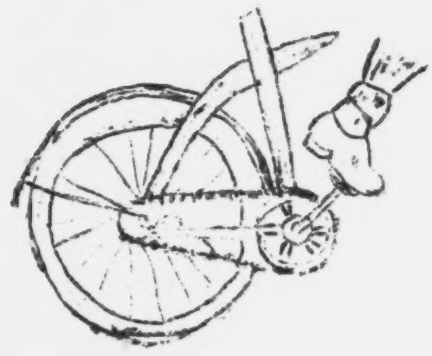
Grade 5: Making It Go

Broad Concept We Want the Children to Learn: We can make things go by using force.

Part A: Muscles Make It Go

Lesson 1 - Problem: What makes your bicycle go?

Materials: bicycle



* See Alternate Experiment page 8.

Have the children:

1. Note how force is transmitted from the legs - to the pedals - to the large gear wheel - to the chain - to the small gear wheel - to the rear bicycle wheel.
2. Note that as a result the bicycle moves forward.
3. Note that one turn of the pedal turns the rear wheel several times.
4. Answer question: Where did the force to make the bicycle go come from? (Elicit: from the push of the legs.)
5. Answer question: What caused the legs to move or push the pedals? (Elicit: the muscles of the legs.)
6. Answer question: What makes your arm move? (Elicit: the muscles in the arm.)

7. Perform experiment: Have each child let one arm hang loose. Have him feel his "biceps" muscle that goes from the shoulder almost down to the elbow. Have children note that a tendon connects this muscle to the forearm bone. Have each child lift his forearm slowly by bending the arm at the elbow. What happens to the biceps? (Elicit: it becomes shorter and thicker.) What does this muscle pull as it shortens? (Elicit: it pulls up the bone in in the forearm causing it to rise.) What do you think causes the bent forearm to unbend and lower itself? (Elicit: another muscle - called the "triceps" does this. It is located in the back of the upper arm.) Can you point out other muscles in your body that you use during the school day? (Elicit: arms, legs, fingers, neck, torso, eyes, lips, etc.)

Suggested Summary of Concepts:

1. Muscles move bones in our bodies.
2. Muscles, by shortening and pulling on bones, make our arms, legs and other parts of our body move. Most muscles work in pairs.
3. We use our arms and legs to move things and ourselves - and to move tools and machines.
4. Tools and machines help make it easier to do many jobs.

Supplementary Activities and Questions:

1. What animals have muscles that make them especially useful to man?
   (Elicit: horses, mules, camels, oxen, water buffaloes, elephants, etc.)
2. At home, or in school, have children look at a chicken leg or a shank of lamb. Have children note the muscles (meat) and the tendons which connect the muscles to the bone. Show how pulling tendons of chicken leg contracts toes.
3. What tools and machines are operated by arms and legs?
   (Elicit: hammer, pencil sharpener, pencil, egg beater, broom, shovel, wheelbarrow, etc.)

Part A: Muscles Make It Go

Lesson 1 - Problem: How do derricks help men do work?

Materials:

1 nail

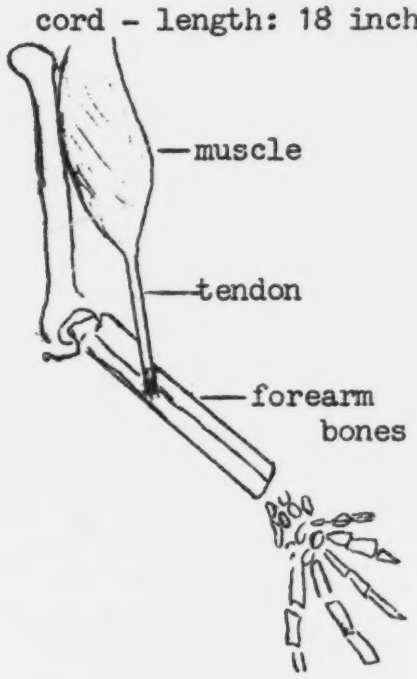
4 screw eyes

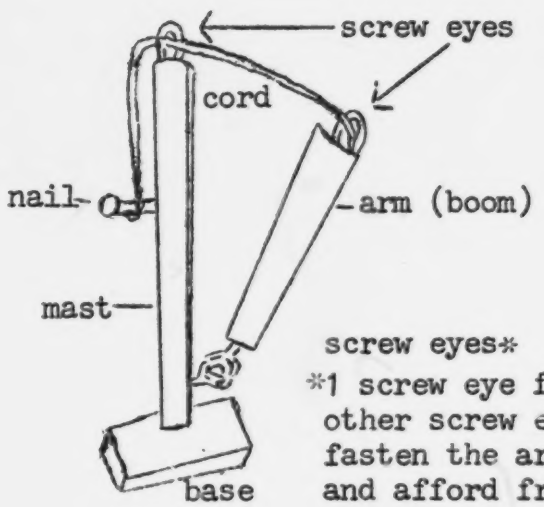
1 base

1 arm

1 mast

cord - length: 18 inches





screw eyes*

*1 screw eye fastened into the other screw eye in order to fasten the arm to the mast and afford freedom of movement required.

Have the children:

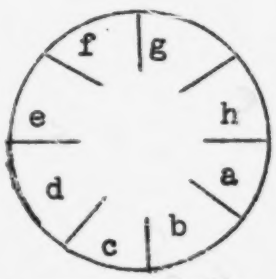
1. Construct a derrick as shown in the diagram.
2. Wind up, pull the cord and notice that the arm (boom) is lifted. The derrick boom is like the forearm. Ask "What lifts the boom?" (the cord) The derrick boom matches the forearm. The cord matches the tendon. The winding device (winch) matches the muscle. When muscles do work they get shorter and thicker (contract). As a muscle contracts it pulls. The ends of muscles are like tough cords called tendons. These tendons attach the muscle to the bone. When the muscle contracts it pulls on the tendon. The tendon pulls on the bone moving it.

Part B: Running Water Makes It Go

Lesson 2 - Problem: How do water wheels help men do work?

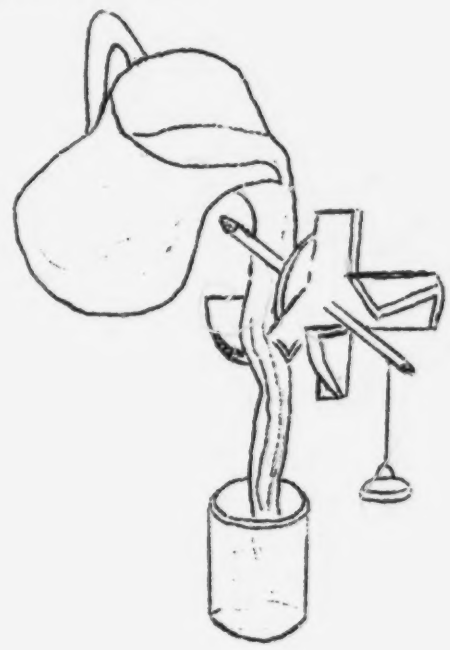
Materials:

1. 3 inch pencil sharpened at both ends
2. one side of a milk carton or a square of cardboard, or thin sheet metal
3. piece of thread
4. tube of glue (optional)
5. button
6. pitcher, or bottle, or large milk carton, for pouring water
7. basin or large tin can to catch water.



Bend corresponding edges (a,b,c - h) up to form "pinwheel" (turbine).

* See alternate experiment (page 11) for "spool water wheel."



Have the children:

1. Cut a circle out of one side of a milk carton or out of a piece of cardboard. Cut and bend the model water wheel as shown in diagram above. Push a 3 inch pencil sharpened at both ends through the water wheel. Tie a button to one end of a piece of thread and have the other end of thread tied or glued to the shaft (pencil) of the water wheel.
2. Place the water wheel under running water.
3. Note the blades turn, the shaft turns, the thread winds up, and the weight is lifted.
4. Discuss operation and use of water wheels and turbines.

Suggested Summary of Concepts:

1. Moving water can turn special wheels called water wheels.
2. Water wheels can do work as water hoists.
3. Turbines can turn other machines (generators, etc.)

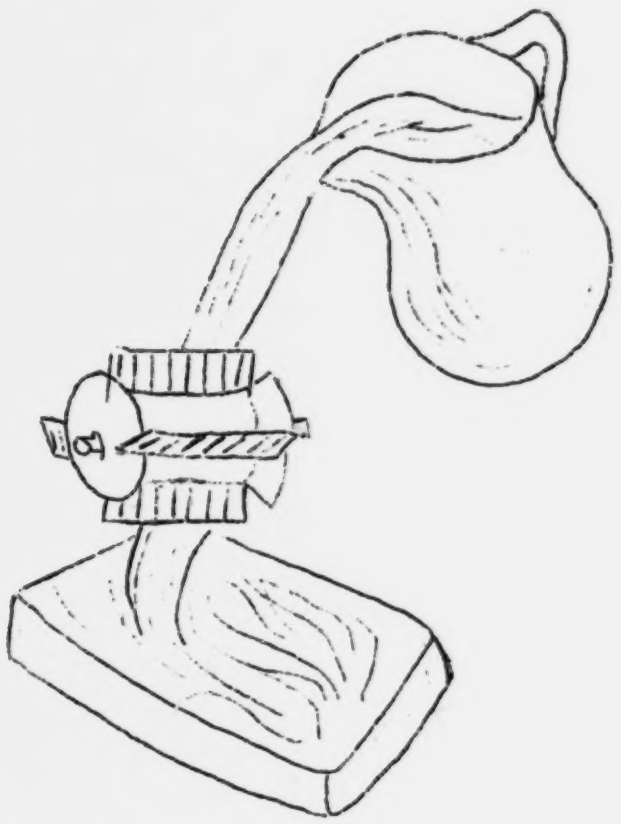
Supplementary Activities and Questions:

1. Have children read about water wheels, turbines and hydroelectric plants. Have children bring their reading sources to class. Make use of the pictures in the several books. Art activities can follow from the pictures.
2. Have children perform other experiments about water wheels or do work on related enrichment areas suggested by Science Manual #6 pages 51-56.

Alternate Experiment

Part B: Running Water Makes It Go

Lesson 2 - Problem: How do water wheels help men do work?



Spool Water Wheel

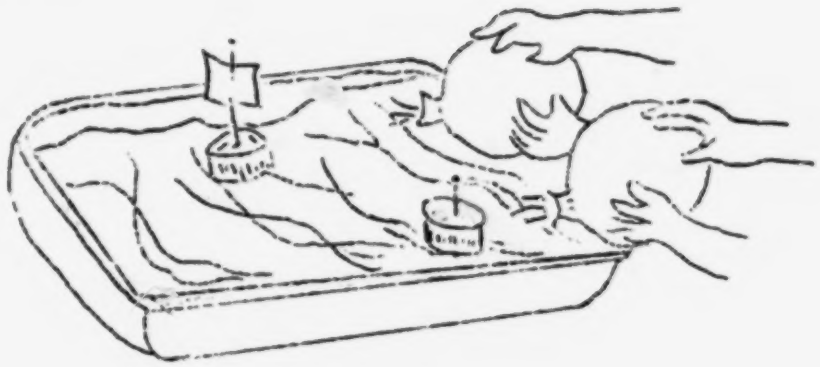
1. Make four radial saw cuts with hacksaw, each about ½ inch deep. Glue 1" wide strips of tin, copper or plastic to these slots. Glue a dowel into spool as shaft.
2. Use as pinwheel turbine (page 9).

Part C: Wind Makes It Go

Lesson 3 - Problem: How do we use wind to make boats go?

Materials:

1. basin to hold water
2. two cork stoppers
3. two straight pins
4. one paper sail
5. two balloons (optional)



Have the children:

1. "Build" two model boats of the corks as shown in the illustration, one with a sail and one without.

(The "sail boats" will need ballast to prevent capsizing. Use a 1"? wood screw or a tin fin.)

2. Conduct a "race" by having the boats blown with either the children's own breaths or with the air in the balloons.
3. Answer the question: Which boat went further - the one with the sail or the one without it?
4. Answer the question: Can sail boats always depend upon a wind?

Wind Makes It Go (cont'd)

Suggested Summary of Concepts:

1. The wind helps move boats by pushing against their sails.
2. The wind cannot always be depended on because it does not blow steadily.

Supplementary Activities and Questions:

1. See Science Manual #6 pages 57-58.
2. Tell a story of the "Horse Latitudes" or the Doldrums. Describe "becalmed."

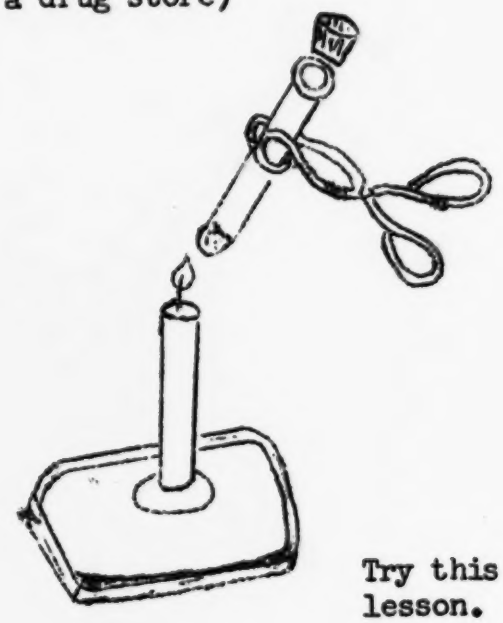
Part D: Steam Makes It Go

Lesson 4 - Problem: How can steam get enough push "pressure" to make things go?

Materials:

(Because of the nature of the equipment and experiment, it is suggested that this experiment should be a teacher demonstration. Caution must be exercised.)

1. a small pyrex test tube (must be pyrex, as a safety precaution.)
2. test tube holder
3. cork stopper
4. vaseline (10¢ tube from a drug store)
5. candle or alcohol lamp
6. matches
7. basin
8. water



Try this out before you teach the lesson.

The teacher performs this experiment:

1. Put about ½" of water into the test tube.
2. The cork stopper should be covered with vaseline to prevent it from sticking to the glass test tube. Then the cork should be inserted loosely into the test tube containing a few drops of water.
3. Place the test tube in the test tube holder.
4. Hold the test tube by its holder in the flame of the candle or alcohol lamp. The open end of the test tube should face away from the children and yourself. Discuss these safety precautions with your children as you go along.
5. Ask the children: "What will happen to the water?" (Steam)

Steam Makes It Go (cont'd)

6. What do you think the steam will do? After a short time the stopper will fly off as steam pressure builds up. Ask the children: Why did the stopper fly off? (Steam pressure forced it to fly off.)
7. Ask again: Compared to the amount of water in the test tube, how much room does the steam take up? (Steam takes up about 1780 times as much room as the water from which it comes,) Can we produce steam without heat? (No.)

Suggested Summary of Concepts:

1. Water turns to steam when heated sufficiently.
2. Steam exerts pressure when it is in a closed place. (Molecules move faster and further.)
3. Steam gets its push ("pressure") from the burning fuel (or from the heat given off by certain atoms - atomic power utilizes the heat of atomic fission.

Supplementary Activities and Questions:

1. See Science Manual #6 pages 59-61; especially note activities pertaining to "How steam turns a wheel."
2. Visit Con Edison plant
3. Use booklet from Con Edison.

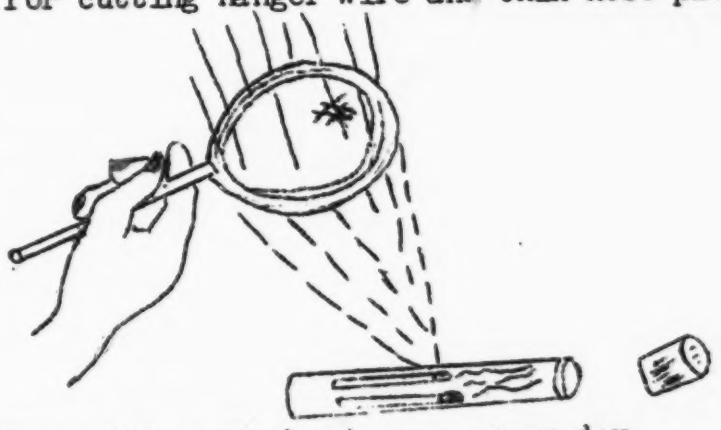
Part E: Fast Burning Makes It Go

Lesson 5 - Problem: How can an automobile engine make a car go?

Materials:

(Again, because of the nature of the equipment and experiment, this experiment should be conducted by the teacher. Caution must be exerted.)

1. two matches
2. pyrex test tube (must be pyrex as a safety measure)
3. cork stopper
4. vaseline
5. magnifying glass
6. thin hanger wire or stiff copper wire (for demonstration on page 17)
7. wire cutter for cutting hanger wire and thin nose pliers to bend wire



The teacher performs this experiment on a sunny day.

1. Place two "stick" matches in a dry test tube. The cork stopper should be covered with vaseline to prevent it from sticking to the glass test tube. Then the cork must be loosely inserted into the test tube.
2. Place the test tube in bright sunlight. With a magnifying glass focus the sun's light rays on the match tips. If the sunlight is strong enough, the matches will catch fire within a short time and the cork will be pushed out of the test tube. Ask the children: What caused the cork to pop out of the test tube? (Elicit: as a match burns it gives off gases and heats the air near it. The hot gases and the heated air push the cork out.)

Try this demonstration in advance. You may need more than two matches. Do not use safety matches.

Fast Burning Makes It Go (cont'd)

3. Compare the foregoing experiment with what happens in a gasoline engine. From the above experiment draw analogies to the automobile engine (internal combusion engine). In your discussion with the children highlight the following:

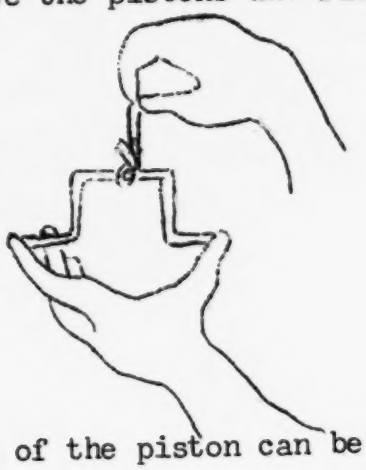
   a. A fine spray of gasoline is mixed with air inside a cylinder of the car motor.

   b. The gasoline - air mixture is set afire by a spark from a spark plug.

   c. The gasoline burns very rapidly (an explosion).

   d. As a result, the heated gases which are produced push against the piston and make it move.

   e. The piston moves and pushes a connecting rod that turns a crankshaft. The turning motion of the crankshaft is ultimately transmitted to the wheels of the car. In a gasoline motor it is a series of explosions that continaully drive the pistons and subsequently to turn the wheels of a car.



4. The up and down movement of the piston can be demonstrated with two pieces of wire as shown in the accompanying illustration. You need a "crankshaft" (1) and a "piston rod" (2)

Manipulate the bent shaped wire to show how it turns. Indicate that this turning motion can be transmitted to the wheels of a car through gears in the "rear end" of the car.

Fast Burning Makes It Go (cont'd)

Suggested Summary of Concepts:

1. The driving force of a car engine comes from burning gasoline.
2. When gasoline burns, it gives off gases and heats the air near it. The heated gases and heated air expand and push.
3. In a gasoline engine, the gasoline is burned inside metal cylinders. In each cylinder there is a piston that can slide back and forth.
4. Each piston in the car pushes a rod which turns a crank or part of a crankshaft. The crankshaft causes the wheels of the auto to turn.

Supplementary Activities and Questions:

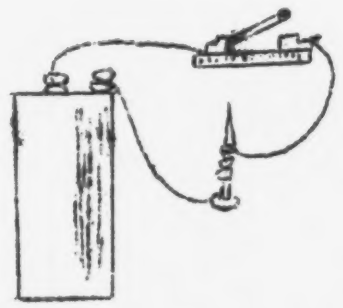
1. See Science Manual #6 pages 62-65.
2. Take the class on a trip to a service station or a car dealer to observe the "insides" of automobiles.
3. Obtain or ask the children in your class if anyone has a "see-through" clear plastic model of an automobile engine, or an airplane piston engine that could be bought to class.
4. Run a model airplane engine.

Part F: Electricity Makes It Go

Lesson 6 - Problem: How can electricity make things go?

Materials:

1. The St. Louis motor, which has clearly visible parts (E-1 List)
2. Two bar magnets
3. String to suspend one bar magnet
4. An electromagnet made from
   a. one or two dry cells (two are better)
   b. insulated bell wire
   c. large iron nail
   d. switch
   e. a few paper clips

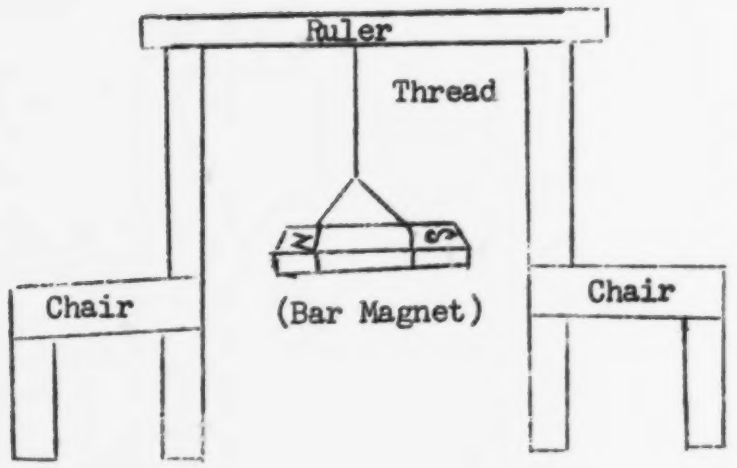


Have a child:

1. Connect up the St. Louis motor to one or two dry cells. Note the visible parts, especially the electromagnets in them. Note the turning of the shaft. With the help of toy gears, wheels and other parts, children may use motors to run devices of their own invention.

Have the children:

1. Determine what is an electromagnet. Wrap about two feet of insulated bell wire around a large iron nail. Always wind the wire in the same direction. Connect a circuit per the diagram. Close the switch. Test the electromagnet to see if it picks up small iron objects, such as paper clips. Note what happens to the magnetism when the circuit is broken (open the switch).



2. Suspend with thread a bar magnet in the classroom. The bar magnet should be away from iron objects. Make the suspended magnet rotate with the help of another bar magnet to be brought close. Discover that unlike poles attract each other and like poles repel. In both instances the suspended magnet can be made to turn or spin.

3. Use an electromagnet to make the suspended magnet turn. Answer this question: Can a suspended magnet be made to spin without moving the electromagnet by turning the current on and off? (Yes)

Suggested Summary of Concepts:

1. Magnetism can be used to produce a spinning motion.
2. Like poles of magnets repel each other and unlike poles attract.
3. Electric motors have electromagnets in them.
4. Attraction and repulsion of electromagnets make motors turn.

* See APPENDIX A: ENERGY CAN BE CHANGED

APPENDIX B: HOW ELECTRIC MOTORS WORK

APPENDIX A

ENERGY CAN BE CHANGED

Energy is the ability to do work. Work is the movement of matter through some distance. Power is a specific word meaning the amount of work done in a given time period.

We do our work by changing energy from one form to another. There are many forms of energy; some of the kinds of energy and their commonly used names are listed below:

chemical:	the energy which can be released from chemical substances. An example is the energy in fuels.
heat:	energy in radiation form. Examples are energy of sunlight and the energy released by the burning of fuels.
light:	another form of radiant energy. This energy can be released from burning fuels as well as in other ways.
mechanical:	energy of movement - a car moves because pistons in its engine receive mechanical energy from the expanding gases that result from burning of fuel.

Other energy forms are electrical, magnetic, atomic or nuclear.

We can trace the energy changes in everyday working situations. The sun's energy is taken in by green plants and stored as chemical energy. Animals eat plants and store this chemical energy in their bodies. We eat both plants and animals, and store this energy, also in chemical form.

We use chemical energy in our bodies in a variety of ways. Our muscles convert chemical energy into mechanical energy, producing movement. For example our heart muscle pumps blood, movements of rib and diaphragm muscle pump air into and out of the lungs, leg and body muscles, in an intricately coordinated "choreography" create walking; other equally intricate teamed muscle arrangements produce work movements such as lifting, pulling or pushing of objects.

Appendix A (cont'd)

Our own musculature is limited in its maximum potential work output. Man has invented "tools" which can increase the force he can bring to bear on a given job. Beyond this force increase, which is always accompanied by an inversely proportional loss of distance of movement, man has invented devices which convert energy from one form to another outside his body.

We burn fuel (coal, oil, wood) changing enemical energy to heat. We use the heat to boil water, making steam. The heat is converted to mechanical energy in the steam. We lead the steam to a steam engine or turbine. The mechanical energy of the steam spins the engine or turbine shaft. We can use this to do work directly (drive a train or boat) or indirectly.

We can use the mechanical energy of the turbine shaft to spin a generator or dynamo, which changes mechanical to electrical energy. This is convenient energy because we can use wires to carry it around. Wherever needed we can use electro-magnets to convert electrical to mechanical energy, as in a motor or magnetic lifting device. We can use a light bulb to change electrical energy to light or a resistance coil to change electrical energy to heat. We can re-store the electrical energy as chemical energy in a storage battery.

We have invented ways of converting solar energy directly to electrical. This is used in space research satellites. "Fuel Cells" have recently been developed for converting chemical energy directly to electrical energy. Other devices are being developed almost daily for changing one form of energy to another.

Up to this point, we have talked about relatively well known energy transformations. In recent years, it has become possible to release literally tremendous amounts of energy from very small amounts of matter in the nucleus of certain substances. There are several kinds of matter whose nuclear energy can now be released with difficult but feasible controllability. In these processes

Appendix A (Cont'd)

some of the material itself is converted into energy. "Atom" and "Hydrogen" bombs are devices in which we can start this process but not control it except by previous determination of size, shape and location of the matter to be converted.

However, in atomic energy "reactors" we can maintain control of energy output and use it as a source of heat for other purposes. The nuclear ship Savannah, now at sea, uses a reactor to boil water. It then uses the steam to drive the ship. Its installations first generate electricity which is used for lighting as well as to drive electric motors which in turn spin its propellors and drives its winches.

APPENDIX B

HOW ELECTRIC MOTORS WORK

We can compare an electric motor to a water wheel or windmill. A water wheel is a wheel that is turned by the force of moving water. In the same sense, an electric motor is a wheel turned by magnetic force which is produced by moving electricity.

The "rotor" in an electric motor is like a wheel because it spins or rotates. There is a coil of insulated wire near the rotor or armature. This coil of wire, called the field winding or stator, and the rotor coils become electro-magnets when electricity flows through them. The rotor is mounted on a shaft that is free to rotate inside the magnetic field of the field winding. The attraction and repulsion between the magnets of the field winding and the rotor magnets makes the armature spin without interruption.

There is a device on the shaft of the rotor called the commutator, which reverses the polarity of the rotor magnet twice during each revolution. This causes each rotor magnet pole to be attracted to the field magnet pole. At the instant the rotor and field poles are closest, the commutator reverses the current in the rotor magnet coils. This reverses the rotor magnet polarity so that the field magnet now pushes the rotor pole away.

The spinning shaft can do work. Thus an electric motor turns electrical energy into mechanical energy.

Teacher's Overview of Language Arts Skills Used in

WHAT MAKES THINGS GO?

Based on MOTION AND FORCE IN TRANSPORTATION

Grade 5

Teacher's cross reference of skills and understandings

The roman numberals in this overview correspond to both the answer sheet numeration following and the numeration of the sections "Checking Up On What We Have Learned" and "Working With Words" in the pupil booklet. It is divided into the three reading levels of each unit.

Level A

I. Alphabetical Order Skill

II. Associating pictures with words-vocabulary mastery

wheel	Lesson 1
bicycle	Lesson 1
sail boat	Lesson 3
magnifying glass	Lesson 5
magnet	Lesson 6

III. Awareness of sequential order

Lesson 4 experiment

IV. Awareness of initial consonant sounds

p, t.

V. Associating letter symbols for final consonant sounds

n, l, t, m, k.

VI. Classifying

Teacher's Overview (cont'd)

Level B

I. Word Attack skills - structural formation

a. seeing differences in details of word formation
b. recognizing known words in compound words
c. rhyming

II. Plural endings

s, es

III. Structural analysis - awareness of endings ed, ing.

IV. Phonetic analysis - distinguishing long and short vowel sounds

V. Synonyms

VI. Antonyms

VII. Finding words in the dictionary - use of alphabetical order

Teacher's Overview ((cont'd)

Level C

I. Prefixes, suffixes, root words

a. Recognition of common prefixes and their meaning

bi, tri, fore

b. Recognition of common suffixes and their meaning

ly, ful, ed

c. Recognition of root words

II. Differentiate between what is true and untrue

III. Recognition of syllables in multi-syllable words

IV. Finding the main idea in a paragraph

V. Expansion of vocabulary

VI. Development of ability to visualize with words

TEACHER'S ANSWER SHEET

For the Science Exercises In the Pupil Booklets

"Checking Up On What We Have Learned"

Level A

Fill in the blank spaces for 1 and 2

1. The push of your _____ makes your bicycle go? (leg muscles)

2. Two parts of our body that do work are _____ and _____. (legs, arms)

Answer questions 3-8

3. Why did the water wheel turn?
(The water wheel turned when we put it under running water.)

4. What is one kind of work that a water wheel can do?
(A water wheel can raise things.)

5. What is wind?
(Wind is moving air.)

6. Why did the sail boat win the race against the other boat that had no sails?
(The sail boat won the race because it was pushed by the wind. A boat without a sail cannot be pushed by the wind.)

7. How is steam made?
(When water is heated, it changes into steam.)

8. Why can steam do work?
(Steam does work by pushing against things. Steam takes more space than water, so it pushes out from a closed-in space. That is why the cork was pushed out of the test tube.)

Pick the correct word. Fill it in for 9.

9. Gasoline is burned inside of a car engine to make it go.
(Gasoline, Oil)

Answer questions 10 - 14. Level A .

10. What does this very quick burning make?
(When gasoline burns it turns into gas.)

11. This very quick burning of gasoline makes a car engine move. Why?
(The gas makes pistons in the engine move up and down. When the pistons go up and down the crankshaft goes around. The crankshaft turns the wheels which make the car go.)

12. Can you name two parts of an electric motor?
(1. wire, 2. electric magnets) (You may get: 1. field, 2.armature

13. What makes an electric magnet work?
(The electric magnets can only work when electricity goes through the turns.)

14. Can you name some things that are run by electric motors?
(Electric train, vacuum cleaner, subway train, et. al.)

Teacher's Answer Sheet - "Checking Up On What We Have Learned"

Level B

Fill in the blank spaces for 1 and 2.

1. The _____ of your legs makes your bicycle go? **(push)**

2. _____ in our arms and legs help us to do work. **(Muscles)**

Answer questions 3 - 10.

3. Why did the water wheel turn?
(The water wheel turned when we put it under running water.)

4. What is one kind of work that a water wheel can do?
(A water wheel can raise things.)

5. What is the push of water called?
(The push of water is called water energy.)

6. What is wind?
(Wind is moving air.)

7. How is steam made?
(When water is heated, it changes into steam.)

8. Why did the sail boat win the race against the other boat that had no sail?
(The sail boat won the race because it was pushed by the wind. A boat without a sail cannot be pushed by the wind.)

9. How can steam do work?
(Steam does work by pushing against things. Steam takes up more space than water, so it pushes out from a closed-in space. That is why the cork was pushed out of the test tube.)

10. What do we call the push of steam?
(The push of steam is called steam pressure.)

Pick the correct word. Fill it in for 11.

11. **Gasoline** is burned inside of a car engine to make it go.
(Gasoline, Oil)

Level B (Cont'd) - - "Checking Up On What We Have Learned"

Answer questions 12-17.

12. What does this very quick burning make?
(When gasoline burns it turns into gas.)

13. How does this burning of gasoline make a car move?
(The gas makes pistons in the engines move up and down. When the pistons go up and down the crankshaft goes around. The crankshaft turns the wheels which make the car go.)

14. Can you name two parts of an electric motor?
(1. wire, 2. electric magnets) (You may get: 1. field, 2. armature)

15. What makes an electromagnet work?
(The electric magnet can work only when electricity goes through the coils.)

16. How do magnets or electromagnets make an electric motor turn?
(The attraction and repulsion between the electromagnets of the field winding and the electromagnet of the rotor or armature cause the rotor to spin. This spinning can do work.)

17. In what ways are electric motors used?
(Electric motors are used in electric trains, vacuum cleaners, subway trains, et. al.)

Teacher's Answer Sheet - "Checking Up On What We Have Learned"

Level C

Fill in blank space for 1 and 2.

1. The _____ of your legs makes your bicycle go. (push or energy)

2. The _____ of water make the water wheel turn. (push)

Answer questions 3-14.

3. What tools or machines work by the push of arms and legs?
   (bicycle, saw ...)

4. Why are tools and machines important to us?
   (Tools and machines are important to us because they help make it easier to do many jobs.)

5. What is one kind of work that a water wheel can do?
   (A water wheel can raise things.)

6. What is the push of water called?
   (The push of water is called water energy.)

7. Explain if we can always depend upon water for energy.
   (We cannot always depend on water for energy because water may not always flow steadily.)

8. What is wind?
   (Wind is moving air.)

9. Why did the sail boat win the race against the other boat that had no sail?
   (The sail boat won the race because it was pushed by the wind. A boat without a sail cannot be pushed by the wind.)

10. Explain if we can always depend upon the wind for energy.
    (We cannot always depend on wind for energy because wind does not blow steadily.)

11. How is steam made?
    (When water is heated, it changes into steam.)

Teacher's Answer Sheet - "Checking Up On What We Have Learned"

Level C (cont'd)

12. Why can steam do work?
(Steam does work by pushing against things. Steam takes more space than water, so it pushes out from a closed-in space. That is why the cork was pushed out of the test tube.)

13. What do we call the push of steam?
(The push of steam is called steam pressure.)

14. How does steam get its push?
(Steam gets it push from the burning of a fuel such as coal, oil, gas, wood and atom power.)

Pick the correct word. Write the correct word in the blank space.

15. Gasoline is burned inside of a car engine to make it go.
(Gasoline, Oil)

Answer questions 16-23.

16. When gasoline burns in an engine, what does it give off?
(When gasoline burns, it gives off gases and heats the air near it.)

17. Why do the parts inside a car engine move?
(They move because the gas makes pistons in the engine move up and down. When the pistons go up and down the crankshaft goes around. The crankshaft turns the wheels which make the car go.)

18. What makes the wheels of a car turn?
(The crankshaft joins with other moving parts in the bottom of the car to make the wheels of the car turn.)

19. Name three parts inside a car engine.
(1. piston, 2. piston rod, 3. crankshaft)

20. Name two parts of an electric motor.

(1. wire 2. electric magnets) (You may get 1. field, 2. armature)

21. What makes an electromagnet work?
(The electric magnet can work only when electricity goes through the turns of wire.)

Teacher's Ans. Sheet. - "Checking Up On What We Have Learned"

Level C.(Cont'd)

22. How do magnets or electromagnets make an electric motor turn?

(The attraction and repulsion between the electromagnets of the field winding and the electromagnet of the rotor or armature cause the rotor to spin. This spinning can do work.)

23. Why are electric motors important?

(Electric motors are important because they provide the energy for many machines and toys that we use daily. Such machines and toys are trains, toasters, phonographs,refrigerators, air conditioners, subway trains, etc.)

TEACHER'S ANSWER SHEET

For the Language Arts Exercises In The Pupil Booklets:

"Working With Words"

Level A

I. By looking at the first letter of each word, put this list of words in the order of the alphabet.

pedals

bicycle

arms

muscles

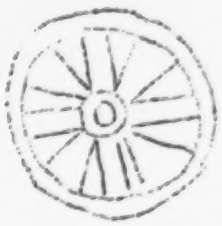
legs

a	(arms)	h		o	v
b	(bicycle)	i		p (pedals)	w
c		j		q	x
d		k		r	y
e		l (legs)		s	z
f		m (muscles)		t	
g		n		u	

II. Put the right word under the picture:

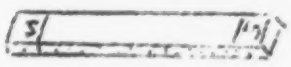
Words: wheel, bicycle, sail boat, magnet, magnifying glass.

(sail boat)



(wheel)

(bicycle)



(magnet)

(magnifying glass)

Teacher's Answer Sheet - "Working With Words"

Level A (cont'd)

III. Put these sentences in the order in which we did the work:

a. We made the water get hotter and hotter.
b. The steam did work.
c. Steam pushed the cork out of the test tube.
d. We got water.
e. The water turned to steam.

1. (d)
2. (a)
3. (e)
4. (c)
5. (b)

IV. Write 3 words beginning with the same first letters as:

pop	tube
1.	1.
2.	2.
3.	3.

V. Put the last letter on these words:

tur (n)

whee(l)

boa (t)

stea (m)

quic (k)

VI. Write each of these 7 words under one of the headings.
match, arm, wheel, leg, sail, muscle, pedal.

A Living Thing That Does Work	A Non-Living Thing Used For Work
(arm)	(match)
(leg)	(wheel)
(muscle)	(sail)
	(pedal)

Teacher's Ans. Sheet - "Working With Words"

Level B

I. Use these new words for exercises a,b, and c below:

turn
axle
electricity
carefully
together

a. Fill in the boxes with the correct word.

1. We saw magnets t u r n one another.
2. A wheel turns on an a x l e
3. In electric wires there is e l e c t r i c i t y .
4. The North Pole of one magnet came t o g e t h e r with the South Pole of another magnet.
5. To prevent anyone from getting hurt we worked c a r e f u l l y

b. Write the word that has two smaller words in it on this line. (carefully)

c. Write another word with the same ending as "turn" on this line. _____

II. Plurals are made by adding plural endings to the end of words meaning more than one. Complete these sentences by giving the plural form:

1. I pushed one pedal.
   I pushed two (pedals).
2. I blew on a boat.
   I blew on two (boats).
3. I used a switch.
   I used two (switches).

III. Add either ed or ing on the word push in each of these sentences:

1. He push ed the pedals with his legs.
2. He is pushing the pedals with his legs.
3. She is now push ing the door.

Teacher's Ans. Sheet - "Working With Words"

Level B (cont'd)

IV. Mark the vowels correctly in the words below either with a long vowel sound mark (-) or with a short vowel sound mark (⏑). Cross out the silent vowels.

Ex.: Māke hŏt

1. leg (lĕg)
2. use (ūse)
3. light (līght)
4. hung (hŭng)
5. pencil (pĕncĭl)

V. Write another word which has the same meaning or almost the same meaning for each of the following words.

1. force (energy, power or push)
2. hoist (lift)
3. each (every)
4. flame (fire)
5. poles (ends)

VI. Write a word which has the opposite meaning for the following words:

1. push (pull)
2. small (big, large)
3. won (lost)
4. bottom (top)
5. few (many)

VII. Divide your dictionary into the 4 parts shown below.

Part 1. is for words beginning with letters a to g.
Part 2. is for words beginning with letters h to n.
Part 3. is for words beginning with letters o to t.
Part 4. is for words beginning with letters u to z.

Put the following words in one of the 4 parts shown above. The first one is done for you.

1. move Part (2)
2. know (2)
3. piece (3)
4. itself (2)
5. own Part (3)
6. safe (3)
7. pressure (3)
8. electromagnet (1)

Teacher's Ans. Sheet - "Working With Words"

Level C

I. a. A root word is the part of a word to which other parts can be added. Draw a ring around the root word in each of the following words:

1. useful ((use)ful)
2. safety ((safe)ty)
3. quickly ((quick)ly)
4. relearn (re(learn))

b. A prefix is a syllable joined to the beginning of a root word. Underline each prefix and give its meaning for each of the following words.

1. biceps (biceps) (two or twice)
2. bicycle (bicycle) (two or twice)
3. triceps (triceps) (three)
4. tricycle (tricycle) (three)
5. forearm (forearm) (before)
6. forehand (forehand) (before)

c. A suffix is a syllable joined to the end of a root word. Underline each suffix and give its meaning for each of the following words:

1. loosely (loosely) (Changes word function: adjective becomes adverb)
2. rapidly (rapidly) (Changes word function:adjective becomes adv.)
3. careful (careful) (Full of)
4. helpful (helpful) (Full of)
5. experimented (experimented) (Past tense of verb)
6. depended (depended) (Past tense of verb)

II. Do you remember lesson 6. In this lesson we did experiments with magnets and electromagnets. Put a cross in front of the sentences about this experiment that are not true.

(X) 1. We saw that an electric motor had no electromagnets.

2. An electromagnet works only when electricity passes through it.

(X) 3. The North Pole of one magnet will pull the North Pole of another magnet.

(X) 4. The North Pole of one magnet will push the South Pole of another magnet.

(X) 5. A "circuit" is a path along which electricity cannot move.

Teacher's Ans. Sheet - "Working With Words"

Level C (cont'd)

III. A syllable is a part of a word that has one vowel sound in it. Put a line between the syllables in each word. Here is a sample to show you how:

sample: energy en/er/gy

1. power (pow/er)
2. second (sec/ond)
3. moving (mov/ing)
4. vaseline (vas/e/line)
5. electromagnet (e/lec/tro/mag/net)

IV. Read the following paragraph. Put a check in front of the sentence below that gives the main idea of the paragraph.

Muscles move bones in our bodies. Muscles, by shortening and pulling on bones, make our arms, legs, and other parts of our bodies move. Most muscles work in pairs. We use our muscles to move our bodies.

1. Muscles are more important than bones.
2. Bones are more important than muscles.
(✓) 3. Muscles move things.

V. Match each of the underlined words with the best statement of its meaning. Write the word in the space provided.

atom, experiment, forearm, tool, hoist.

1. Something that man uses for doing work by hand. (tool)
2. A machine that lifts things. (hoist)
3. A testing to find out about something. (experiment)
4. The smallest part of an element. (atom)
5. The front of the arm from the wrist to the elbow. (forearm)

VI. Complete each of the following sentences:

1. A windy day reminds me of _____

_____

2. Riding in an elevator makes me _____

_____

3. My muscles feel like _____
4. Doing an experiment is _____

RESOURCES

For WHAT MAKES THINGS GO?

Based on MOTION AND FORCE IN TRANSPORTATION, Grade 5.

Professional Books for Teachers:

Blough, Glenn O., Schwartz, Julius, and Huggett, Albert J.: Elementary School Science and How to Teach It, Revised Edition, N.Y.: Holt, Rinehart & Winston, Inc., 1958

Blough, Glenn O., and Campbell, Marjorie H.: Making and Using Classroom Materials in the Elementary School. N.Y.: Holt, Rinehart and Winston, Inc., 1954.

Hone, Elizabeth B., Joseph, Alexander, Victor, Edward and Brandwein, Paul F.: A Source book for Elementary Science. N.Y.: Harcourt, Brace and World, Inc., 1962.

Roy, Mary M.: Probe A Handbook for Teachers of Elementary Science. Educational Services Inc., Benton Harbor, Michigan, 1962.

UNESCO Source Book for Science Teaching, Revised. UNESCO Publications Center 801 Third Avenue, N.Y. 22, N.Y., 1963.

Children's Books, Grade 5 - Interest Level:

Blackwood, Paul E.: Push and Pull: The Story of Energy, N.Y.: McGraw-Hill, 1959.

de Camp, L. Sprague: Energy and Power. N.Y.: Golden Press, 1962.

de Camp, L. Sprague: Engines. N.Y.: Golden Press, 1961.

Hilgrom, Harry: Exploration in Science: A Book of Basic Experiments. N.Y. E.P. Dutton and Co., 1961.

Notkin, Jerome J. and Gulkin, Sidney: The How and Why Wonder Book of Machines. N.Y.: Wonder Books, 1960.

Filmstrips:

Machines Help Us Travel: Eye Gate House N.Y.C. Bd. of Ed. Item #37365.31

Getting Power From Engines: McGraw-Hill

How water Produces Electricity: Pat Dowling Pictures

Films:

We Use Power: Churchill--Wexler Film Productions

Engines and How They Work: Coronet Instructional Films

Energy: Gateway Productions

Free Materials:

Source: Elementary Teachers Guide To Free Curriculum Materials - Educators Progress Service, 1962.

WHAT MAKES THINGS GO?

Based on MOTION AND FORCE IN TRANSPORTATION, Grade 5.

Following is a list of difficult and critical words used in Lessons 1-6. Pupils should be pre-tested on these science and general reading words to ascertain what pre-teaching vocabulary needs exist among the pupils. Vocabulary should be taught functionally, as needed in the science lessons, but following the appropriate experiment.

Reading Level A Lesson 1	Reading Level B Lesson 1	Reading Level C Lesson 1	Reading Level C (cont'd) Lesson 1
also	ahead	also	most
arms	arms	arm	move
because	around	biceps	muscle
bicycle	bicycle	bicycle	ourselves
legs	called	bodies	pairs
muscles	chain	bone	parts
pedals	force	causing	passed
pushed	gear	chain	pedals
pushing	help	connects	pull
turn	know	easier	remember
wheel	leg	experiment	rise
work	legs	felt	shorter
	move	first	small
	moved	forearm	straightened
	muscles	forward	tendon
	pedals	gear	thicker
	push	hang	tools
	pushed	help	triceps
	small	jobs	turned
	turned	large	wheel
	watch	legs	
	wheel	loose	
	work	lower	
		machines	

Reading Level A
Lesson 2

helped
kind
raise
running
small
things
turned
water

Reading Level B
Lesson 2

axle
both
button
held
itself
lifted
model
other
part
pencil
piece
sharpened
string
things
tied
turn
turning
used
water
weight

Reading Level C
Lesson 2

around
axle
button
center
could
experimented
find
first
flowing
happened
hoists
hold
lifts
machine
model
part
pencil
problem
raised
running
second
shapened
third
thread
tie
turns
water
weight

Reading Level A
Lesson 3

against
air
balloon
beat
boat
boats
blew
blowing
found
moving
other
push
race
sail
two
win
wind

Reading Level B
Lesson 3

against
air
balloon
believe
blowing
boat
call
each
interesting
learned
moves
moving
own
pushing
race
sail
sails
used
wind
won

Reading Level C
Lesson 3

answer
balloon
between
blew
cork
depended
helps
learned
make-believe
moving
steadily
wind

Reading Level A
Lesson 4

class
cork
hot
hotter
our
out
pop
saw
steam
test
tube
things

Reading Level B
Lesson 4

carefully
charged
closed
cork
filled
flame
flew
fly
heating
needed
pressure
steam
suddenly
test
tube

Reading Level C
Lesson 4

boil
built
burned
burning
closed
covered
everyone
faced
flame
flew
fly
forced
fuel
glass
happened
heated
holder
next
placed
pressure
push
question
steam
sticking
stopper
suddenly
test
tube
vaseline

Reading Level A
Lesson 5

again
burning
burns
car
engine
gasoline
glass
inside
light
magnifying
match
matches
more
move
together
wheels

Reading Level B
Lesson 5

around
burning
burns
engine
focused
gas
gasoline
glass
happen
inside
light
magnifying
matches
sides
stopper
wheels

Reading Level B
Lesson 5

bottom
crankshaft
engine
experiment
focus
gas
gasoline
inside
instead
iron
joins
light
magnifying
match
piston
point
pushing
quick
rapid
rod
round
slides
standing
stick
together
wheels

Reading Level A Lesson 6	Reading Level B Lesson 6	Reading Level C Lesson 6
Electric	bar	bar
electricity	brought	cells
hands	cells	circuit
insides	clips	clips
iron	close	discover
magnet	covered	dropped
magnets	different	dry
motor	dry	electric
pick	electric	electricity
pull	electricity	electromagnet
round	electromagnet	electromagnets
through	electromagnets	hung
wire	hung	iron
	iron	joined
	kinds	length
	large	magnet
	length	magnets
	magnet	motor
	magnets	N. (abbr. for North)
	motor	nail
	nail	opened
	paper	path
	pulled	picked
	pulling	pole
	switch	S. (abbr. for South)
	tested	study
	these	switch
	through	touching
	touching	width
	understand	wire
	wide	worked
	wire	
	wires	
	wondered	